Working Paper

Document de travail

Tax Policy and Legislation Branch

Department of Finance

Direction de la politique de l'impôt et de la législation

Ministère des Finances

THE GOODS AND SERVICES TAX: A GENERAL EQUILIBRIUM ANALYSIS

by

Bob Hamilton and Chun-Yan Kuo

Working Paper 89-3

The authors are extremely grateful to Katie Johnson and Ceo Gaudet for their valuable assistance in developing the model and data used for this analysis. In addition, valuable comments and suggestions were provided by David Dodge, Michael Horgan, John Lester, David Moloney, Michael Sabia, John Sargent, Michael Smart, and John Whalley. Any remaining errors or ommissions are, of course, the responsibility of the authors.

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90-02076/

RÉSUMÉ

Afin de mesurer les effets à long terme de la réforme de la taxe de vente, le ministère des Finances a élaboré un modèle régional d'équilibre général de l'économie canadienne. Ce document a pour but de fournir une description détaillée de cette analyse. Les données utilisées dans ce modèle reflètent la structure de l'économie canadienne qui existait en 1984. Les données concernant les taxes de vente fédérale et provinciales ont été ajustées afin de tenir compte des changements importants qu'ont subies ces taxes depuis 1984.

Les modèles d'équilibre général ont été utilisés de façon croissante au cours de la dernière décennie dans le but d'analyser l'impact de diverses questions fiscales et de commerce international. Cette approche nécessite l'incorporation de données économiques observées dans un cadre théorique cohérent. Dans ce contexte théorique, les effets des changements de taxes sur les prix relatifs et sur les activités dans certains secteurs clé peuvent être analysés.

Les résultats de l'analyse suggèrent que la réforme de la taxe fédérale de vente amènera une hausse de la production de l'économie canadienne de 1.4 pour cent ou 9 milliards de dollars de 1989. Les gains de production les plus significatifs seront réalisés dans les secteurs à forte intensité de capital et axés sur les exportations, grâce à l'élimination de la taxe de vente sur les biens d'équipement. Les gains de revenu réel des Canadiens représenteront environ 0.9 pour cent du PIB.

ABSTRACT

This paper describes the Department of Finance's analysis of the long-term economic effects of sales tax reform. For the purpose of this analysis, the Department has developed a regional general equilibrium model of the Canadian economy. The data used in the model reflect the structure of the Canadian economy in 1984. However, the federal and provincial sales tax data were adjusted to reflect the substantial changes to these systems since 1984.

General equilibrium models have been used increasingly over the past decade to analyze a variety of tax and trade policy issues. The approach involves incorporating observed data for an economy into a theoretically consistent economic framework. Within this framework, the effects of the tax change on relative prices and on activity in key sectors can be analyzed.

Results of the analysis suggest that sales tax reform will increase the real output in the economy by approximately 1.4% or $9 billion in 1989 dollars. The largest real output increases occur in capital-intensive, export-oriented sectors due to the removal of sales taxes on capital goods. The real income gain to Canadians is about 0.9% of GDP.

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1. INTRODUCTION

Sales tax reform represents a fundamental change to the Canadian tax system and will affect virtually every producer and consumer in the Canadian economy. Replacing the existing federal sales tax (FST) with the Goods and Services Tax (GST)[1] will do more than simply redistribute the tax burden from one sector or group in the economy to another. By removing the many distortionary features of the existing sales tax system, the GST will allow the economy to operate more efficiently, resulting in increased production and real income for Canadians.

Analyzing the economic effects of sales tax reform requires an economy wide perspective and a model which is able to quantify the economic benefits from a more neutral sales tax system and the distribution of these benefits across sectors. In addition, since sales tax reform will also involve changes to the personal income tax system, the model must be capable of analyzing the effects of simultaneous changes to different components of the tax system. The most appropriate approach for this type of analysis is general equilibrium (GE) modelling.

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1. The Goods and Services Tax is a tax, similar to the European value-added tax, on the consumption of goods and services in Canada. Details of this tax can be found in Department of Finance (1989).

General equilibrium models have been used increasingly over the past decade to analyze a variety of tax and trade policy issues. Basically, the approach involves incorporating observed data for an economy, in this case Canada, into a theoretically consistent economic framework. Within this framework, the effects of the tax change on relative prices and on activity in key sectors can be analyzed.

This paper describes the key features of the regional GE model used to assess the long-term economic effects of sales tax reform. The model incorporates data on the structure of economic activity in each of the regions of the country, in order to identify the consequences of sales tax reform for these regions.

Implementation of the GE approach consists of five basic steps. First, an appropriate model structure is selected to analyze the policy change being considered. This includes choosing functional forms to characterize producers' and consumers' behaviour and selecting the level of detail, in terms of regions, industries and consumer goods, required to capture the major economic effects of the policy change.

Second, observed economic data are incorporated into a GE structure to produce a data set for use in the model. The GE structure assumes that relative prices adjust to ensure that all markets are in a state of equilibrium. Incorporating actual economic data into this GE structure produces a data set for the economy in an initial state of equilibrium -- this is the benchmark equilibrium.

Third, the substitution elasticity values used in the model's functions are exogenously specified and are obtained from empirical studies in the literature. The remaining parameters are then determined by a calibration process which ensures that the model reproduces the benchmark equilibrium as a solution under the existing policy regime.

Fourth, a policy change is introduced into the model -- in this case, the replacement of the FST by the GST and the associated income tax measures. The model then solves for the new set of prices and quantities which produce an equilibrium under the new policy regime -- this is the counterfactual equilibrium.

Finally, the benchmark and counterfactual equilibria are compared to reveal the effects of the tax change on key economic variables such as real output, demands and incomes, in aggregate and for individual sectors.

An advantage of the GE approach is that it captures the workings of the entire economy in a theoretically consistent framework, providing insights into the complex interactions of all markets in response to a major structural change in the tax system. It can reveal the effects of a policy change on the allocation of resources in the economy and the distribution of real output gains among sectors as a result of this reallocation.

Results of the analysis suggest that sales tax reform will increase the real output in the Canadian economy by approximately 1.4% or $9 billion in 1989 dollars. The largest real output increases occur in capital-intensive, export-oriented sectors due to the removal of sales taxes on capital goods. The real income gain is about 0.9% of GDP, reflecting the fact that some of the benefits of increased output accrue to foreigners in the form of payments for imports of additional capital services.

This approach allows for the analysis and measurement of the long-term changes in potential output and national income arising from sales tax reform. It does not permit, in and of itself, an analysis of the transition path from the current equilibrium to the post-reform equilibrium. The results of the GE analysis presented in this paper can be used as a benchmark for the new equilibrium in short term macroeconomic models used to analyze the transition.

The paper is organized as follows: Section 2 discusses the detailed structure of the regional GE model; Section 3 describes the data and parameters used in the model; and the final section presents the results of our analysis of sales tax reform.

2. A Regional General Equilibrium Model

The regional GE model developed for this analysis uses the same theoretical structure as most other GE models used for policy analysis.[2] A GE model can be separated into two components -- the production side and demand side. On the production side, producers are assumed to maximize profits from the sale of goods and services which are produced using primary factors and intermediate inputs.

On the demand side, households are assumed to maximize their utility from consumption of goods and services subject to their budget constraint. This budget constraint is determined by the income they receive from their endowments of primary factors and from government transfers.

The model reveals how primary and intermediate inputs are transformed into producer goods and, in turn, consumer goods which yield utility to households. Beyond

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2. The basic concepts can be found in Harberger (1962) and Shoven and Whalley (1984).

this basic structure, each model has some distinguishing characteristics, usually reflecting the specific policy issue being analyzed.[3]

2.1 Key Features of the Model

Although the model has much in common with other GE models, there are four important features which set this model apart from many of the others: the explicit modelling of Canada as a small open economy; the fact that each region's economic activity is separately identified; the linkage between the cost of capital in production and the price of capital goods; and, the detailed representation of the distortions of the existing sales tax system.

2.1.1 A Small Open Economy

Canada is an open economy, fully integrated into global capital markets and heavily dependent on international trade. The presence of a large international market which presents an alternative source of supply and demand for

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3. For instance, the GE model used here is different in several respects from the GE model used by the Department of Finance to analyze the Canada - U.S. Free Trade Agreement. See Harris (1988).

tradeable goods means that sales tax reform has quite different economic effects than one would predict in a closed economy.

A variety of foreign sector specifications can be found in other GE models of Canada.[4] One basic approach has been to add on a set of "closure" rules to the domestic model by specifying import supply and export demand functions for the foreign sector.[5] The elasticity values used in these functions then determine the responses of the foreign sector to domestic policy changes. Another approach uses an Armington-type specification which differentiates between products according to where they are produced.[6] The substitution elasticities between domestic and foreign goods are then specified to reflect Canada's role in global markets.

Incorporating an appropriate representation of the foreign sector into the model raises difficult technical issues and inevitable trade-offs between precision and tractability. In the end, the appropriate representation of

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4. See, for instance, Boadway and Treddenick (1978), Jenkins and Kuo (1985), Thirsk (1986), Damus (1986) and Harris (1988).

5. Whalley and Yeung (1984) discuss this conceptual issue.

6. This approach is common in analysis of trade policy issues. See Armington (1969) for a conceptual discussion and Harris (1988) for an application to Canada.

the foreign sector hinges on the policy issues to be analyzed. In order to adequately analyze the effects of sales tax reform, the model must contain enough detail on the domestic economy to enable it to capture the effects of the sales tax system on producers and consumers. Incorporating this level of detail in the domestic economy precludes a very detailed representation of the foreign sector.

Our analysis of sales tax reform is based on the premise that Canada is a small economy which has little influence on global supply and demand for tradeable products. Furthermore, foreign products are assumed to be perfect substitutes for products produced in Canada. This implies that prices for tradeable products are set according to global supply and demand conditions and that Canada must adapt to these prices in determining its domestic production and consumption patterns. However, the analysis attempts to account for the fact that the prices of products which are not traded on world markets, such as structures produced by the construction sector, are determined entirely by domestic markets. While the prices of these non-tradeable products are exogenous in the model, adjustments are made to the parameters in these sectors to reflect the fact that there is no international trade in these products.

The modelling technique adopted here has the advantage of being relatively simple to implement as well as

capturing the essence of Canada's role in the global economy.[7] This is not to say that the assumption that Canada is a price-taker in all markets cannot be challenged. Indeed, for some internationally traded commodities, the price-taking assumption may not be appropriate (e.g., uranium and natural gas). However, at the broad sectoral level used in this analysis, the price taking assumption appears to be appropriate.[8]

Explicitly modelling Canada as a small open economy has several implications for the structure of the model. Treating domestic and foreign goods as perfect substitutes gives rise to the potential for complete specialization in production in response to tax policy changes. To ensure that all goods continue to be produced, there must be at least as many internationally immobile factors of production as there are traded goods.[9]

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7. The explicit application of a small open price-taking model to the Canadian economy can be found in Lenjosek and Whalley (1986), and Hamilton and Whalley (1989). Other studies, such as Harris (1984) and Harris (1988), assume Canada is a price-taker for imports, but has some influence on export prices.

8. Furthermore, to date, no studies have identified precisely which Canadian products might enjoy market power in world markets. Applebaum and Kohli (1979) rejected the hypothesis that Canada was a price-taker on export markets. However, there appears to be no empirical evidence to suggest that the Canadian supply of a particular product can influence the world price for that commodity, or, if so, to what extent it can do so.

9. See Samuelson (1953).

A common method of resolving this issue, in both theoretical and empirical analysis, is through the use of sector-specific factors of production.[10] In this analysis, each sector is assumed to use a specific factor, yielding a sufficient number of factors to implement the approach.[11] Unlike the other factors of production, these factors are assumed to be unable to move between industries or regions and, therefore, the return earned by these factors varies across industries and regions.

The small open economy framework also has important implications regarding the incidence of the sales tax. It implies that Canadian producers will be able to pass sales taxes on to consumers in the form of higher prices only to the extent that import-competing products produced abroad contain the same amount of tax. Since foreign producers do not pay FST on their inputs, domestic producers will not be able to pass on these taxes. In addition, the FST taxes domestically produced goods more heavily than

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10. See, for instance, Clarete and Roumasset (1985).

11. These industry-specific factors are typically thought of as natural resources, highly-skilled labour or specific machinery and equipment. However, there is little data on the returns to these specific factors in national accounts data. This analysis assumes that a portion of labour is industry-specific.

imported goods.[12] These additional sales taxes levied on domestically produced goods will, under the small open economy assumption, be passed backward and ultimately will be borne by the factors of production.

2.1.2 Regional Economic Activity

The Canadian economy is composed of a number of regions, each of which has its own unique economic structure. As a result, tax policy changes can have very different effects on the various regions of the country. In order to capture these effects, the model identifies 12 different regional economies -- 10 provinces and 2 territories.[13]

Each region is composed of 12 industries. Producers in each industry face an exogenously determined world price for their tradeable products and maximize their profits

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12. The extent of the disparity in favor of imported goods was estimated to be approximately one-third of the domestic effective FST rate in 1984. This estimate was computed from a survey undertaken by Woods Gordon Ltd. of Toronto. Results can be found in the Department of Finance (1987), p. 17.

13. The structure of this model is different from the regional model found in Jones and Whalley (1988). The scope of the model used in their analysis is very broad and it is capable of analyzing a wide variety of policy issues. However, it is not detailed in its treatment of sales tax issues. In contrast, the model described in this paper has a very narrow focus and was specifically designed to analyze sales tax issues.

based on the relative price of their inputs (including taxes) and the parameters describing their production techniques.

These regional economies interact with each other, and with the rest of the world, by importing and exporting goods and services -- including capital services -- for final consumption and for use as inputs in production.

Each region has its own consolidated provincial/local government that receives revenue from taxes, returns on its capital and transfers from the federal government. Its expenditures include transfer payments to households and purchases of goods and services.

The federal government interacts with each region by collecting tax revenue in the region, paying transfers to the region's households and governments and purchasing goods and services produced in the region. For the country as a whole, federal government revenues equal expenditures. However, the federal government's expenditures in a region will typically not be equal to the revenue it raises from that region.

2.1.3 The Cost of Capital in Production

The removal of existing sales tax on capital goods is expected to reduce the cost of capital used to produce goods and services in Canada. As a result, special attention is paid to the model's representation of capital services used in production and the effects of the GST on the relative price of those services.

The standard approach to modelling the production process in a static model focuses on the productive services flowing from primary factors in a particular period. In other words, the capital stock and the labour force yield a service flow in each period and it is these services that are used in the production of goods and services. In the case of capital, these services yield a return to the owners of capital in each period. This return, net of corporate taxes, is referred to as the rental price of capital (r). Perhaps the simplest way to think of this process is as a leasing arrangement where the capital owners lease the capital to producers each period for a price equal to r.

In models where it is assumed that capital is perfectly mobile internationally and Canada plays a small role in global capital markets, the rental price is typically assumed to be exogenously determined on world

markets.[14] The cost of this capital to the user is the rental price plus any taxes on capital (e.g. corporate taxes).

In order to fully capture the effects of the FST in this type of formulation, it is important to recognize the link between the price of a capital good and the rental price of the capital services yielded by that capital good when it is used in the production process. Although capital services are not directly subject to FST, the price of these services reflects the FST on the capital good itself. In other words, if the lessor has to pay sales tax on a capital good, this will be reflected in higher lease payments by the lessee.

The FST thus increases the cost of capital used in Canada and this is true whether the capital is domestic or imported. Imported capital goods are also subject to the FST, whether they are purchased or leased. In the model, the rental price, or the user cost of capital, is assumed to be related to the price of the capital good by the following equation:

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14. See, for instance, Hamilton and Whalley (1989).

$$\psi = \frac{r}{P_k} \qquad (1)$$

where ψ is the net of capital tax rate of return on capital, P_k is the gross of sales tax price of capital goods used in Canada and r is the rental price of capital services used in Canada. Because capital is assumed to be perfectly mobile, the net of corporate tax rate of return on capital is assumed to remain constant from the benchmark equilibrium to the post-reform equilibrium.

Removing the FST from capital goods will reduce P_k. The fact that ψ remains constant implies that the rental price of capital services will adjust such that, in the long run, the percentage change in r will equal the percentage change in P_k. The reduction in r will stimulate demand for capital services, expanding real output and increasing capital service inflows.

2.1.4 Representation of the Sales Tax System

Modelling the GST is relatively straightforward since it applies a single rate of tax to final consumption on a broad range of goods and services. In contrast, the FST applies prior to the retail level on a narrower range of commodities, producing a situation where effective FST rates vary significantly across commodities and producer's inputs

bear a substantial sales tax burden.[15] These features are also present, albeit to a lesser extent, in the provincial retail sales taxes (PST).

In an effort to capture these distortions in the analysis, considerable attention is paid to the channels through which the FST affects economic decisions. An example is the detailed modelling of the production process which allows for substitution among intermediate inputs in response to tax-induced relative price changes. Producers are assumed to alter their input mix in response to the relative price changes resulting from the removal of the FST from their inputs. The model also allows for substitution between trade margins and other taxable goods and services. This is an important consideration for sales tax reform since these margins, which are currently not taxed, will be brought into the GST base.

The relative price of goods and services to final consumers will also be affected by the PSTs. The model

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15. The effective sales tax rate for each commodity is defined in this paper as the ratio of the direct sales taxes on the commodity to the producer price of the commodity. The effective FST rates vary considerably across commodities and the estimates can be found in Kuo, McGirr and Poddar (1988).

incorporates detailed data on how both the FST and the PSTs are reflected in relative prices faced by producers and consumers.

2.2 The Structure of the Model

As mentioned, the model consists of 12 different regional economies, each with a different pattern of production and consumption. The underlying structure and functional forms are assumed to be identical with the data determining the parameter values specific to each region. To facilitate the description of the model's structure, it is useful to consider each region as a separate sub-model and regional subscripts are suppressed in all equations.

2.2.1 The Production Side[16]

In the model, a regional economy consists of 12 industries, each of which is treated as producing a single commodity. These industries are: primary; minerals and energy products; food; beverage and tobacco; non-durable manufacturing; durable manufacturing; construction; transportation; retail and wholesale trade; services; utilities; and public administration.

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16. A detailed description of the production side of a model which is closely related to this one can be found in Whalley (1985).

Production in each industry involves two different sets of inputs -- primary factors and intermediate inputs. A fixed input requirement per unit of production is assumed for a composite of primary factors and for a composite of intermediate inputs. If X_j denotes the output of the jth commodity, Y_j the value-added by primary factors in producing the jth commodity, and H_j the use of the composite of all other commodities in producing the jth commodity, the production function can be written as:

$$X_j = \text{Min} \left(\frac{Y_j}{v_j}, \frac{H_j}{a_j}\right) \qquad j = 1, 2, \ldots, 12. \quad (2)$$

where v_j is the fixed composite value-added requirement per unit of output of the jth commodity, and a_j the fixed composite intermediate good requirement per unit of output of the jth commodity.

a) Value-Added

A CES value-added function is used to describe the substitution possibilities between primary factors -- capital (K), labour (L), and an industry-specific factor (F) -- in each industry. The value-added function for the jth industry is:

$$Y_j = A_j \{ \alpha_{kj} K_j^{-\rho_j} + \alpha_{lj} L_j^{-\rho_j} + \alpha_{fj} F_j^{-\rho_j} \}^{\frac{1}{-\rho_j}} \qquad (3)$$

where A_j is a scale parameter, α_{kj}, α_{lj} and α_{fj} are the factor intensity parameters, and ρ_j is a parameter which is related to the elasticity of factor substitution (σ_j) by the equation $\sigma_j = 1/(1+\rho_j)$.

Firms select the cost minimizing combination of primary input requirements in meeting the per unit value-added requirement in the production of each good. The relationships between the relative price of the factors and the demand for these factors per unit of output in each industry are:

$$\frac{l_j}{k_j} = \left(\frac{\alpha_{lj}}{\alpha_{kj}} \right) \left(\frac{r_j^*}{w_j^*} \right)^{\sigma_j} \qquad (4)$$

$$\frac{f_j}{k_j} = \left(\frac{\alpha_{fj}}{\alpha_{kj}} \right) \left(\frac{r_j^*}{u_j^*} \right)^{\sigma_j} \qquad (5)$$

where k_j and l_j and f_j stand for the demand for capital, labour and industry-specific factor per unit output of the jth commodity; r_j^*, w_j^* and u_j^* are the factor prices including factor taxes, respectively.

The per-unit demand for capital can be expressed as:

$$k_j = A_j^{-1}\left[a_{kj}\left(1 + \left(\frac{a_{lj}}{a_{kj}}\right)^{\sigma_j}\left(\frac{r_j^*}{w_j^*}\right)^{\sigma_j-1} + \left(\frac{a_{fj}}{a_{kj}}\right)^{\sigma_j}\left(\frac{r_j^*}{u_j^*}\right)^{\sigma_j-1}\right)^{\frac{\sigma_j}{1-\sigma_j}}\right] \qquad (6)$$

The per-unit demand for the other factors can be derived and expressed in a similar fashion.

The extent to which production factors can relocate in response to relative price changes is different for each factor. Capital is assumed to be fully mobile across sectors, regions, and internationally. Thus, the equilibrium rate of return on capital is uniform across all regions and equal to the rate determined in global markets. In equilibrium, an excess demand for capital services in Canada will result in an increase in the amount of capital services imported from abroad.

Labour is assumed to be mobile intersectorally but not interregionally or internationally. Hence, in equilibrium the amount of labour used by each industry

adjusts to ensure that wage rates are uniform within a region, but can differ across regions.[17]

Industry-specific factors are assumed to be completely immobile. As a result, specific factor returns adjust to ensure an equilibrium and the returns to these factors will typically vary across industries and regions.

In equilibrium, the model requires that domestic endowments of labour and industry-specific factors are fully employed; that is:

$$\sum_{j=1}^{12} l_j \cdot X_j = \bar{L} \qquad (7)$$

$$f_j \cdot X_j = \bar{F}_j \qquad j = 1,2,\ldots,12. \qquad (8)$$

b) Intermediate Inputs

In addition to primary factors, each industry uses the outputs of its own and other industries as intermediate

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17. This is an analytic simplification and may not reflect the actual workings of the economy where labour is able to move between regions in response to wage differentials, unemployment rate differentials, or locational preference. However, empirical studies have yet to produce estimates of the extent to which labour is mobile between regions which can be incorporated into GE analysis.

inputs. The 12 intermediate inputs specified in the model include transportation margins, trade margins and 10 other commodities. Cost-minimization by producers determines the quantity of each of these 12 commodities required to form the composite intermediate input in each industry.

The substitution possibilities among intermediate inputs are represented by a three-level nested CES function. The first level specifies substitution possibilities across the 10 non-margin goods. At level 2, substitution occurs between a composite non-margin good and transportation margins. Finally, substitution takes place between the level 2 composite commodity input and trade margins to form a composite intermediate input.

In equilibrium, no firm makes surplus profits, which implies that the producer's price of each commodity (P_j) equals its unit cost including the gross-of-tax payments to primary factors and intermediate inputs. This can be expressed as:

$$P_j = r(1 + t_{kj})k_j + w(1 + t_{lj})l_j + u_j(1 + t_{uj})f_j + \sum_{i=1}^{12} P_i(1 + t_{ij})a_{ij} \; ; \quad j = 1,2, \ldots, 12. \qquad (9)$$

where r, w and u_j are the net-of-factor tax price of capital, labour and industry-specific factor; a_{ij} is the per-unit use of the ith good in the jth industry; t_{kj} is the ad valorem tax rate on the jth industry's use of capital; t_{lj} is the ad valorem tax rate on the jth industry's use of labour; t_{uj} is the ad valorem tax rate on the jth industry's use of specific factor; and, t_{ij} is the combined ad valorem rate of the federal and provincial excise and sales taxes levied on the ith good used in the jth industry.

The model's representation of the production process outlined above permits a very detailed representation of the decisions of producers in the presence of taxes. The FST, by taxing some intermediate inputs, distorts the relative prices of these inputs and thereby alters their use in the production process. As a result, producers choose less than the economically efficient level of inputs which are taxed, and more than the efficient amount of untaxed inputs. The move to the GST removes these distortions and the model captures the effects on producer's decisions and the resulting increases in efficiency.[18]

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18. In contrast, a model where the intermediate inputs were a fixed proportion of total output would not be able to capture the effects of these distortions.

2.2.2 The Demand Side

The 12 producer goods are demanded domestically by the household sector indirectly in the form of consumer goods, the investment sector and federal and regional governments. In addition, these goods are demanded by foreigners in the form of exports.

The demand functions for domestic agents are derived from maximization of CES utility functions subject to the agent's budget constraint. Agents receive income from endowments of primary factors and from government transfers. The excess demand or supply of a product by foreigners is determined by residual as the difference between the domestic supply of a product and its domestic demand.

a) Households

Households derive utility from the consumption of consumer goods. There are nine consumer goods identified in the model: food and non-alcoholic beverages; alcohol and tobacco; clothing and footwear; housing; energy; household products; services; autos and repairs; and others.

Demands for these consumer goods imply demands for the underlying producer goods. For example, purchases of

clothing and footwear imply demands for producer goods such as non-durable manufacturing, retail margins and transportation. This feature of the model captures the efficiency gains which result from broadening the sales tax base to include retail, wholesale and transportation margins.

Households select their consumption bundles so as to maximize their utility at the prevailing set of relative prices, subject to their budget constraint. A household's consumption decisions are based on a six-level nested CES utility function of the form:

$$U = \{ \sum_{i=1}^{9} b_i \, C_i^{-\theta} \}^{-\frac{1}{\theta}} \qquad (10)$$

where C_i is the household's consumption of the ith consumer good, b_i is the distribution coefficient, and θ is a parameter which satisfies the equation $\delta = 1/(1 + \theta)$ where δ is the elasticity of substitution among consumer commodities.

The six-level nesting structure allows for the use of different elasticity values for different consumer

categories.[19] For instance, empirical estimates of the own-price elasticity of demand for food are quite different from estimates for household products and services. The nested structure allows the use of these different elasticities, whereas single-stage CES functions require that only one elasticity value be used.

A household's budget constraint (I) is defined as total income earned from factor endowments and transfer payments received from the government less personal income taxes. This can be expressed as:

$$I = (1 - t_I)\,(wL + rK + \sum_{j=1}^{12} u_j F_j + G) \qquad (11)$$

where t_I is the average personal income tax rate (federal plus provincial) in the region, and G is the transfer payments received by households from both levels of government.

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19. The substitution elasticity in a CES function can be approximated by the own-price elasticity of demand for a commodity if the commodity's expenditure share is small. Therefore, by singling out individual commodities at different levels of the nest, the substitution elasticity can be set at approximately that commodity's own-price elasticity.

Maximizing utility subject to this budget constraint yields the following demand functions for the ith consumer good:

$$C_i = \frac{b_i^{\delta} I}{\hat{P}_i^{\delta} \sum_j b_j^{\delta} \hat{P}_j^{(1-\delta)}} \qquad i = 1,2,\ldots 12. \quad (12)$$

where $\hat{P}_i$ is the price, including sales taxes, of the ith consumer good.

b) Investment

It is extremely difficult to accurately represent the observed dynamic phenomenon of savings and investment in a static model. The treatment of savings adopted in this model follows a relatively standard approach adopted in other static models, see for example Hamilton and Whalley (1989).

Savings observed in the benchmark equilibrium are assumed to represent purchases of capital goods by an investment sector. This investment sector is best thought of as a mutual fund which uses the economy's savings to purchase capital goods. The investment sector's capital goods purchases are based on maximization of a CES utility function and, therefore, these decisions are influenced by the FST imposed on capital goods.

c) Government

The model has two government sectors in each region -- the federal government and a consolidated provincial/local government sector. Both government sectors collect revenues from their respective factor taxes (corporate, property and payroll), excise and sales taxes, other production taxes (net of government subsidies), and personal income taxes. A portion of the government's revenue is used to provide transfer payments to the various households. The remaining revenue is retained by government and is used, along with capital income from government-owned capital, to finance its expenditures on goods and services. Subject to this budget constraint, each government maximizes its utility according to a single-level CES function.

d) External Sector

From the perspective of an individual region, the external sector represents the other regions in Canada and the rest of the world. Since each region is modelled as a small open price-taking economy, the external sector will either supply or demand unlimited quantities of traded goods and capital services at world prices. Therefore, the excess demand for a product by the external sector is determined residually by the difference between the region's production of that product and the demand for that product within the region.

The zero external balance condition dictated by the GE framework requires that the value of net exports plus net transfer payments received must equal net capital service inflows:

$$\sum_{j=1}^{12} P_j E_j + T_r - \left(\sum_{j=1}^{12} r K_j^D - r \bar{K}\right) = 0 \qquad (13)$$

where E_j is net exports of commodity j; K_j^D is capital demanded by industry j; $\bar{K}$ is the domestic endowment of capital; and T_r is the net transfer payments received by the region.

2.3 Solving for an Equilibrium

When a policy change, such as replacing the FST by the GST, is simulated, relative prices will adjust and resources in the economy will be reallocated until all the required equilibrium conditions are re-established.

The procedure used to solve for this counterfactual equilibrium yields useful insights into the linkages within the model. The process of solving for an equilibrium in this model differs from that typically used in many other GE models. The key differences stem from the fact that in the small open price-taking economy framework, the prices of goods and the rental price of capital are exogenously determined.

Basically, solving the model involves iterating through the production and demand sides of the model at different assumed GST rates until all markets clear and the federal government revenues are restored. The procedure can be summarized as follows:

1) Select an initial value for the GST rate necessary to restore government revenues;

2) Find the regional wage rates and the allocation of capital and labour in each region which equate each factor's value marginal product to its per unit factor return. This is an iterative procedure involving the following steps:

   a) use assumed values for regional wage rates and for the allocation of capital across regions and sectors to calculate the equilibrium value marginal product for labour in each industry.

   b) calculate the labour allocation across industries which is consistent with the assumed wage rate and labour's marginal product in each industry.

   c) repeat steps (a) and (b) above with alternative regional wage rates until each region's labour services are fully employed.

d) calculate the capital use by industry consistent with the labour allocations in (c) and the factor prices.

e) repeat steps (a) through (d) above until the capital allocations calculated in (d) are consistent with those assumed in (a).

3) Use the labour allocations across sections along with the full employment condition for labour, equation (7), to determine the output of each industry;

4) Use the zero profit condition, equation (9), to solve for the return to each industry's specific factor;

5) Calculate relative prices and each agent's income from factor endowments and government transfers in order to derive final demands for each commodity;

6) Determine the per-unit intermediate input demands for each industry and use these along with the industry's output to determine total intermediate demands for each commodity;

7) Solve for the foreign excess demand (or supply) for a product as residual of the domestic supply of the product less domestic demand (final plus intermediate) for the product;

8) Use the total domestic demand for capital services and the domestic endowment of capital services to determine net capital service outflows; and

9) Check that government revenues equal the revenue requirements. If not, revise the GST rate in (1) and repeat steps (2) through (8) until an equilibrium is reached.

3. MICROCONSISTENT DATA AND PARAMETERS

Constructing a microconsistent data set for Canada provides the link between the observed economic data and the theoretical structure of the GE model described above. This section describes the methods and main data sources used in constructing the 1984 regional microconsistent data set.[20] In addition, details are provided on federal and provincial sales tax data used in the model and the values used for a number of key elasticities in the model.

3.1 A Regional Benchmark Data Set

The GE framework explicitly assumes that the economy is initially in a state of equilibrium with no excess demands in product or factor markets. As a result, the GE framework imposes a set of equilibrium conditions on the benchmark data set. The nature of these equilibrium conditions depends somewhat on the structure of the model used for the analysis. In a small open price-taking economy, the equilibrium conditions include:

- the value of output produced by each industry equals the cost of production in that industry;

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20. For a complete description of this process, see St. Hilaire and Whalley (1983).

- the demand for factors of production is equal to the supply of those factors;

- the economy's transactions with the external sector are in balance; and

- each agent's income equals its expenditures plus net savings.

There are two broad approaches to constructing a regional benchmark data set. The first, a top-down approach, involves constructing a national data set which can then be disaggregated into separate regions according to a set of distributive series. The second, a bottom-up approach, means constructing a regional data set directly from available provincial data.

For this analysis, the former approach was adopted since the Department had already constructed a national data set for 1984 which satisfied all of the GE conditions. In addition, this approach ensured that the regional data set would be completely consistent with the national data set.[21]

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21. In practice, the regional micro-consistent data set had to be based on preliminary provincial input-output data which did not always sum precisely to the national aggregates in each sector.

The cornerstone of the national benchmark data set is Statistics Canada's 1984 national input-output (I/O) tables. These tables provide two sets of interrelated accounts; a set of commodity accounts showing the supply of and demand for each individual commodity, and a set of industry accounts showing the total gross output of each industry and each industry's total inputs. These data sets are provided by the MAKE matrix, USE matrix and FINAL DEMAND matrix of the I/O tables.[22]

These accounts satisfy one of the basic conditions necessary for GE analysis -- the value of output equals the total cost of production for each industry -- and thus provide a natural starting point for constructing a consistent data set. Nevertheless, three major adjustments to this data are needed in order to provide a benchmark data set suitable for use in the GE model:

- incorporating a better measure of value-added by industry;

- specifying a complete set of transactions with the foreign sector; and

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22. The description of these matrices can be found in Statistics Canada, (December 1987).

- constructing a complete set of income and outlay accounts.

The methodology and conditions described above also apply to the construction of a regional benchmark data set used in the GE analysis. However, the task is more complicated for a regional model since it is necessary to specify each region's economic activity including its interactions with other regions in Canada and the rest of the world.

Constructing a data set at the regional level gives rise to some concerns regarding the reliability of the data. As a result, although the model uses data on 12 regions and 12 sectors, the empirical results are presented for a more aggregated set of regions and sectors. The data, and thus the results, on this move aggregated basis are considered to be more reliable.

The data for the regional GE model were derived by disaggregating the national benchmark data set described above using the provincial I/O tables and the provincial economic accounts. The following sub-sections describe the development of the national data set and the additional steps necessary to construct a regional data set.

3.1.1 Measuring Value-Added by Industry

In the national accounts, an industry's value-added is separated into two basic components: payments (gross of taxes) to capital and payments (gross of taxes) to labour. In the GE model, payments to capital include profits, investment income, the imputed return to government-owned capital and owner-occupied dwellings, an imputed charge for financial services and the return to capital from self-employment income. This return is measured as net of depreciation. Payments to labour include wages and salaries and the return to labour from self-employment income. For this model, the returns to specific factors also need to be identified and this is discussed below.

a) Return to Capital by Industry

The National Income and Expenditure Accounts (NIEA) are used as the starting point for developing a measure of capital returns by industry. The NIEA data reports the gross-of-tax capital return which consists of corporation profits before taxes and miscellaneous investment income. The following adjustments are made to this series:

1) A separate industry is identified to incorporate the economic activities of governments. This "public administration and defence" industry

employs labour and capital and produces output which is fully consumed by governments. The imputed return earned by the government on its own capital stock is computed by assuming the same gross-of-tax rate of return as non-government capital stock.

2) Government royalties paid by businesses are treated in the I/O tables as an intermediate expense and are located in the finance, insurance and real estate industry. However, in this model royalties are modelled as a tax on capital. Therefore, these expenses are removed from the finance industry and, instead, allocated across all industries as part of capital taxes.

3) Self-employment income in each industry is split between returns to capital and labour using the industry's ratio of profits and other investment income to wages and salaries.

4) The NIEA measures the return to capital as net of capital consumption allowance (CCA) in order to account for depreciation of the capital stock. However, the NIEA's measure of depreciation is based on the historical cost of assets and as such does not measure economic depreciation. In order

to get a measure of capital return which more adequately reflects economic depreciation, the CCA is added back to the NIEA return to capital and an estimate of economic depreciation by industry is subtracted.[23]

5) An adjustment is made to inventory valuation by industry. The adjustment is designed to remove any capital gains or losses resulting from the inventory accounting procedures of business firms.[24]

This gross capital return is then separated into a net-of-tax return and capital taxes. Capital taxes are defined here to consist of federal and provincial corporate income taxes, property taxes, and government royalties.[25] The regional federal and provincial corporate income taxes paid in each industry were calculated using provincially

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23. Estimates of economic depreciation are obtained from Statistics Canada, (September 1987).

24. See Statistics Canada (September 1975).

25. Federal and provincial corporate income taxes paid by each industry were obtained from Statistics Canada, (August 1988) These were then scaled to sum to the NIEA aggregate. Government royalties paid by each industry were obtained from the I/O tables and then scaled to sum to the NIEA aggregate.

disaggregated data for corporate taxable income at both the federal and provincial levels.

Data on real and personal property tax payments are not available for each industry. However, in aggregate, it is known that these taxes represent 75% of the taxes contained in the "other indirect taxes" category of the I/O tables.[26] This ratio was assumed to be constant across industries. Thus, the estimates of real and property taxes paid by an industry were obtained by multiplying the "other indirect taxes" paid by that industry by 75%.

Using the national benchmark data set, an industry's payments to capital are disaggregated across regions according to that region's share of total capital payments in that industry in the 1984 provincial I/O tables.

b) Return to Labour by Industry

The model uses a measure of the return to labour in each industry which includes wages, salaries, the labour portion of self-employment income, and all taxes on labour. An adjustment is made in the services industry to reallocate labour income and labour taxes originating from government

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26. The value of total real and property taxes recorded in the NIEA is equal to about 75% of the value of total other indirect taxes found in the I/O tables.

provided services into the "Public Administration and Defence" industry.[27]

Labour taxes include contributions made by both employers and employees to unemployment insurance, Canada and Quebec pension plans and workmen's compensation.[28] For each industry, these taxes were assumed to represent the same proportion of total labour payments across all provinces -- implying that the effective labour tax rate for an industry is the same across the country.

Starting from the national data set, an industry's payments to labour are disaggregated across regions according to that region's share of total labour payments in that industry in the 1984 provincial I/O tables.

c) Return to Industry-Specific Factors

After the value-added for capital and labour is calculated, estimates of the returns and associated taxes

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27. In the original I/O tables, the value-added by the government sector is found in the final demand (FD) matrix. However, for the GE model developed in this paper, it is necessary to remove value-added from the government sector in the FD matrix, and instead include these as factor returns in the "Public Administration and Defence" industry.

28. This unpublished data is provided by the Labour Division of Statistics Canada and is scaled to sum to the NIEA estimates in order to ensure consistency.

for industry-specific factors are needed in the regional model. Although the use of industry-specific factors in the model solves the technical problem of complete specialization, it is very difficult to obtain precise data on the returns to these specific factors. In the absence of this data, the specific factor returns in the model were calibrated to be consistent with exogenously specified output supply elasticities.

For the production structure used in this model it can be shown that an industry's output supply elasticity is related to its elasticity of factor substitution and to the share of the specific factor in that industry in the following manner:

$$\eta_j = \sigma_j \left(\frac{1 - \phi_j}{\varepsilon_j}\right) \qquad j = 1, \ldots, 1^? \qquad (14)$$

where η_j is the output supply elasticity; σ_j is the elasticity of substitution between factors of production; ϕ_j is the industry-specific factor's share of value added; and, ε_j is the industry-specific factor's share in total output.

Using this equation, an exogenously specified output elasticity can be used along with the benchmark data to specify the returns to specific factors by industry. Although specific factors could reasonably be assumed to be capital, labour or both, our analysis assumes that a

portion of labour is industry-specific. This greatly simplifies the data manipulations since both specific factors and labour are assumed to be owned by the region that uses them, whereas capital used in a region can be owned outside the region.

In most industries, a long-run output supply elasticity of 1.5 was assumed.[29] Lower elasticities were used in the construction, trade, and service sectors, as an approximate way of recognizing the lower demand elasticities for these largely non-traded products.

3.1.2 Specifying Transactions with the External Sector

A comprehensive representation of transactions with non-residents must include not only trade in goods and services but also interest, dividends and investment flows across borders. The I/O tables provide a detailed breakdown of trade by commodity, however, they are inadequate for this purpose because they only report trade in goods and some services. Therefore, the I/O tables need to be supplemented by another source, the Balance of International Payments (BIP), which provides a complete set of statistics which captures

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29. Again, there are very few empirical estimates of these values in the literature. However, a study by Thirsk and Wright (1977) did estimate values in this range for the energy sector.

all transaction with foreigners. The BIP data are used in conjunction with the I/O data in order to construct a complete set of external sector accounts.

The BIP can be separated into two basic components; a current and capital account. The current account can be further separated into merchandise trade, services and flows of investment income (interest, dividends, etc.). The capital account records financial investments by Canadians abroad and by non-residents into Canada.

The I/O data are used to provide a detailed breakdown of exports and imports by commodity which is necessary for the model. The trade levels by commodity are scaled to the aggregates contained in the BIP to ensure consistency of the data set.

In this model, each region is a small open economy. The difference between a region's supply of a commodity and the demand for that commodity by the region's industries and agents represents the region's net trade for that commodity. This net trade can be in the form of either interprovincial or international trade. The sum of interprovincial trades across all regions is equal to zero. Therefore, Canada's net trade with the rest of the world remains the same as in the national benchmark data.

In GE analysis, it is important to determine which agent owns the capital used in production in a region. While there is relatively good data available on international flows of capital, there is no such data available on flows within Canada. This fact makes it difficult to specify each region's endowment of capital. Trela and Whalley (1986) assume that each region's capital endowment is equal to the capital used in that region's industries. This assumes no cross-regional ownerships of capital. For our analysis, income from capital observed in the national data set is distributed to each region using a distributive series, constructed from the capital income data in the provincial economic accounts. Therefore, a region's use of capital in production will not typically equal its endowment of capital and the difference represents its net capital income flows.

3.1.3 Completing Income and Outlay Accounts by Sector

A basic condition of GE analysis is that each agent must satisfy its budget constraint; that is, the sum of expenditures and net savings must equal total disposable income, including transfers but net of personal taxes. Any difference between income and outlay in the observed data is considered net lending or borrowing. The sum of net lending or borrowing across all sectors in the economy must equal zero.

There are five basic agents in each region: households, the federal government, the regional government, investment, and the external sector. Income is obtained from the factor returns on labour, capital and specific factors, as well as transfer payments from federal and provincial governments. Each agent's outlay is determined by its gross-of-tax expenditures on goods and services. Any difference between an agent's income and its outlay must be offset elsewhere in the economy. Before entering the data into the model all agents' savings are set to zero by transferring income from net savers to net borrowers. In this way, all income earned in the economy is expressed either as a demand for consumer goods or capital goods.

The only difference in this regard between the regional and the national benchmark data set is the treatment of government. In the national model all levels of government are represented as one consolidated agent whereas the regional model splits the government into two components -- federal and all other government including municipalities, universities, schools and hospitals. In light of this, the regional model must incorporate additional intergovernmental transfers.

The Provincial Economic Accounts (PEA) provide a starting point for consistent income and outlay data for both the federal and regional governments. The PEA data can

be used to determine the transfers made by both the federal and all other governments to each agent in the economy. From this data source, it is also possible to determine the tax revenue earned by the governments in each of the provinces.

Both the federal government and provincial governments receive income from factor taxes, personal income tax and medical insurance by households, indirect taxes net of subsidies paid by households, business and foreign sectors. Meanwhile, governments pay indirect taxes on their purchases and buy domestic and imported products, all of which are considered part of their outlay.

The provincial government receives revenue from taxes on economic activity within the region, capital returns and transfer payments received from the federal government. In total, the income earned by a provincial government equals its outlay in the region.

On the other hand, the federal government collects tax revenue and makes expenditures in all provinces. Overall, the federal government's income equals its outlay; however, this does not necessarily hold in a particular province.

3.1.4 Ensuring Overall Consistency

The process described above has essentially taken a set of consistent I/O tables and altered and supplemented them to incorporate better measures of economic activity. As a result, it is necessary to examine the entire data set (after the adjustments) to ensure that it satisfies the basic equilibrium conditions set out at the beginning of this section. The key step in this process involves modifying the elements of the intermediate use matrix until it satisfies pre-specified row and column sums.[30]

3.2 Detailed Sales Tax Data

In order to capture adequately the sales tax distortions, the benchmark data set must identify the sales tax paid on each commodity, whether it be an intermediate input of an industry or final consumption by one of the agents.

Indirect taxes in the I/O tables consist of three types of taxes: commodity indirect taxes, subsidies, and other indirect taxes. Commodity indirect taxes refer to taxes imposed on commodities produced or sold, and as such

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30. See St. Hilaire and Whalley (1983) for a description of this process.

include a federal, provincial and local tax component. Clearly, further detail on these taxes is required to adequately assess the effects of altering the federal sales tax system.

Other indirect taxes consist of property taxes, motor vehicle licence fees and other licences and fees imposed on business, taxes on natural resources, property taxes, and other business taxes. Since property taxes are considered to be taxes on capital in this model, they are subtracted from other indirect taxes. The remaining indirect taxes are combined with subsidies and treated as net production taxes in the benchmark data set.

The extent of the distortions caused by the federal and provincial sales tax systems will be an important determinant of the consequences of sales tax reform for the economy. These distortions are reflected in the effective sales tax rates on final demands, business inputs, and capital goods. Thus, the model requires detailed data on federal and provincial sales taxes paid by each industry and final demand sector on each of 12 commodity classifications for each of the 12 regions.

These data were provided by Statistics Canada, based on a study undertaken for this analysis.[31]

The effective FST and PST rates on final demands are calculated as the ratio of the direct taxes paid to total expenditures exclusive of taxes. These rates are then adjusted to reflect changes to the sales tax systems since 1984. In a similar fashion, the FST and PST collected on intermediate business inputs can be converted to effective tax rates on the use of a commodity in an industry. These rates are also adjusted to reflect changes to the sales tax system since 1984.

In the small open economy framework, the effective sales tax rate on capital goods can be separated into two components -- the direct sales tax paid on machinery and equipment, and the indirect sales tax paid on buildings. Since machinery and equipment are treated as traded goods, only direct sales taxes on these goods are reflected in a higher cost of capital. All indirect sales tax paid on machinery and equipment are assumed to be borne by producers.

Although no direct sales tax is paid on construction there is a substantial amount of indirect tax paid on

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31. See Siddiqi and Murty (1989); and Murty, Généreux, LeBlanc and Greenberg (1989).

building materials. Since construction is essentially a non-traded good, the indirect sales tax paid on these goods are assumed in the long run to be passed forward to consumers in the form of higher prices.

The sales tax rates on capital goods were estimated for all industries using the 1984 I/O data and then adjusted to reflect changes to the federal and provincial sales tax system since 1984. The average effective FST rate on capital goods is estimated to be approximately 4 per cent while the effective PST rate on capital goods is about 3.7 per cent for the nation as a whole.

3.3 Elasticities and Other Parameters

The GE model uses CES functions to characterize the behavior of producers and consumers. The use of CES functions requires that elasticities of substitution be specified for all functions. These elasticity values are critical to the analysis, but reliable estimates are difficult to obtain. Consistent with the standard GE approach, we have used the best available estimates from the literature and have performed sensitivity tests where possible.

The two most critical elasticities used in the model are the own-price elasticity of demand for consumer

goods and the factor substitution elasticities. The own price elasticities of demand for consumer goods can be grouped into two categories; one is a low elasticity of .5 for food, alcohol/tobacco, clothing and fuel and the other is a high elasticity of 1.3 for household goods, services and transportation.[32]

On the production side, the model requires estimates of elasticities of substitution among capital, labour and industry-specific factor for various industries. Factor substitution elasticities for the manufacturing, food and beverage/tobacco sectors were obtained from Taher, McMillan, Gillen and Buse (1985). Elasticity values in this range were also assumed for all other sectors.

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32. See Powell (1965).

4. SIMULATION RESULTS

Sales tax reform involves a number of changes to the sales and income tax system which are designed to be revenue-neutral to the federal government. In addition to replacing the FST, the revenue from the GST will be used to: substantially enrich the refundable sales tax credit; reduce the personal taxes on middle income households; finance the automatic indexation of the income tax and transfer payments caused by the one-time price effect of the GST; provide rebates of tax to the provinces and selected public sector institutions; and, to finance the special housing measure.[33] The analysis of sales tax reform is based on the FST rates which existed prior to the April 1989 budget.

Before turning to the empirical results, it will be useful to outline, in a qualitative manner, the economic effects expected as a result of sales tax reform.

The existing FST creates several distortions on the production side of the economy. First, and most importantly, the FST is applied to some capital goods used in the production process. While the effect of this tax varies across industries and across types of assets, on average, it represents about 4% of the price of capital goods. The removal of these taxes from capital goods should, over time, lower the cost

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33. See Department of Finance (April 1989).

of capital to domestic producers, leading to increases in investment, productivity and domestic real output.

Second, the FST is applied to other business inputs, such as motive fuels, building materials and telecommunication services. These taxes distort the relative prices of inputs to the production process thereby causing producers to choose their inputs inefficiently. Perhaps more seriously, these taxes apply to domestic producers but not to foreign producers. Removing these input taxes will benefit Canadian industries, in particular, exporters attempting to compete on global markets.

Third, the FST taxes domestic products more heavily than imported products. On average, the FST on domestic products is about one-third higher than for comparable imported goods. By effectively moving the sales tax to the retail level, the GST will remove the existing bias in favour of imported products and thereby stimulate domestic production in these sectors. The removal of these biases will yield efficiency gains by improving the allocation of the economy's resources and producing a more efficient pattern of international trade.

In summary, the reform should have substantial impacts on real output, particularly for products which rely heavily on taxed inputs and those which compete on

international markets -- either exports or import-competing domestic products.

The GST will also have important effects on consumer demand. By applying a uniform tax rate to a broad range of goods and services, the GST will substantially reduce the distortion of relative prices caused by the FST. This will result in consumption decisions more in line with the underlying economic conditions and will enable market forces to allocate economic activity more efficiently.

The economic benefits resulting from a more efficient allocation of the economy's resources will increase the real income of the economy. This real income gain will be spread across all regions. The associated changes to the income tax system, such as the enrichment of the refundable sales tax credit, will yield relatively large gains for low and middle income groups.

With these qualitative effects in mind, we now turn to the empirical estimates of the reform, focusing on the real output response by sector and by region and on changes in real income.

4.1 Sectoral Effects on Real Output

In aggregate, our analysis suggests that sales tax reform will increase the real output of the economy by approximately 1.4% or about $9 billion in 1989 dollars.[34] It should be noted that this analysis was performed on the basis of the FST system prior to the April 1989 budget. Incorporating the FST rate changes announced in that budget would increase the real output gain by an additional 0.1%. The expansion in real output is largely attributable to the removal of the distortions to the relative prices of production inputs, resulting in an increase in the use of capital services and in factor productivity.

Our analysis also suggests that sales tax reform will alter the pattern of flows between Canada and the rest of the world. In aggregate, the increased demand for capital services stimulates additional imports of capital services from abroad and a corresponding increase in net exports which ensures that Canada's transactions with the

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34. This estimate is larger than two previous estimates of the impacts of sales tax reform -- Thirsk (1985) and Hamilton and Whalley (1989). The differences can be explained largely by the fact that neither of these other studies adequately captures the effect of removing the sales taxes on capital goods on the cost of capital to Canadian firms. In addition, the Thirsk study did not reflect the significant changes to the FST since 1984.

foreign sector remain in balance. The increase in net exports is comprised of an increase in exports and a decrease in imports. However, there are two opposing effects on imports. On the one hand, there is an increase in domestic consumption due to the economic benefits of the reform and this acts to increase imports. On the other hand, the removal of the sales tax on inputs and the import bias causes proportionally more of this demand to be met by domestic production, tending to reduce imports. The net effect is a decrease in imports.

The extent of the change in real output varies by sector. In general, sectors which currently pay a substantial amount of FST on their inputs -- such as the primary and utilities sectors -- expand the most. These sectoral effects are summarized in Table 1.

Table 1

Sectoral Effects on Real Output
(percentage)

Sector	
Primary	3.3
Food/Beverage/Tobacco	0.3
Manufacturing	1.4
Construction	1.6
Transportation & Utilities	3.1
Services	1.6
TOTAL	1.4

The primary sector, which includes agriculture, forestry, fishing and mining, experiences a large output gain due to its extensive use of taxed inputs -- especially in the mining sector. In addition, this is a very export-oriented sector.

The food, beverage and tobacco sector expands very slightly since taxable inputs account for a relatively small portion of its production activity. As a result, the removal of sales tax from production inputs has relatively little impact.

The manufacturing sector is composed of durable goods (e.g. machinery, equipment) and non-durable goods other than food, beverage and tobacco products (e.g. clothing, plastics). Real output increases in these sectors largely because of the removal of the existing system's bias in favour of imports. This sector pays relatively little FST on its production inputs and therefore, real output does not increase by as much as some of the other sectors.

The removal of tax from building materials results in a significant increase in the output of the construction sector. However, this sector does not benefit from increased international competitiveness since trade in construction products is very limited.

The transportation and utilities sector is one of the biggest beneficiaries of the reform, particularly the utilities sector, which purchases a great deal of taxed inputs under the current system. The transportation sector also expands significantly due to the removal of FST from its inputs such as fuels and some vehicles.

The service sector contains a very broad range of industries including: financial services; business services; communication services; personal services; and retail and wholesale trade. In total, this sector accounts for a significant portion of the economy's GDP. In general, these industries pay a substantial amount of tax on their inputs under the current system since most of what they purchase is not production equipment and thus not eligible for exemptions. This sector gains a little more than average primarily because of its highly taxed inputs, an increased demand for business services, and the removal of the existing tax on telecommunication services.

4.2 Regional Consequences

A uniform-rate sales tax applied to a very comprehensive base, such as the GST, will have only limited regional implications in a small open price-taking economy. It will affect regions differently only to the extent that regions have different ratios of consumption to income.

Otherwise, taxes will be borne in proportion to the consumption activity in that region.

However, the existing FST has definite regional implications. Because of its narrow tax base and its taxation of production inputs, it will affect regions differently to the extent that these regions have different production and consumption patterns. Therefore, the effects of replacing the FST with a GST are expected to differ across regions.

The effects of the reform are shown in Table 2. Each region gains substantially, with the Prairies being the largest gainers. The nature of production in the Prairie provinces -- particularly the resource sector's reliance on taxed inputs in the production process -- is the primary reason for this large expansion. Similarly, the Atlantic provinces and British Columbia gain substantially from the removal of tax on inputs to production in their industries.

The real output gains in Ontario and Quebec are significant, but slightly below the national average. These provinces contain a wide variety of industries, but do not contain as heavy a concentration of primary industries as other regions. Indeed, on average, the industries located in these provinces are not as severely affected by the FST on production inputs and this leads to the below-average increase in real output.

Table 2

Effects on Real Output by Region
(percentage)

Region	
Atlantic	1.4
Quebec	1.0
Ontario	1.1
Prairies	2.5
British Columbia	1.3
CANADA	1.4

4.3 REAL INCOME EFFECTS

The effects of the tax change on the real income of Canadians incorporates the effects of the reform on both prices and incomes. It reveals the extent to which Canadians are better or worse off as a result of the reform.

By removing the various economic distortions caused by the FST, relative prices and therefore supply and demand will become more in line with underlying economic conditions. This will improve the allocation of resources in the economy and thereby increase the real income of Canadians. Our analysis suggests that the real income of the economy will increase by as much as 0.9% of GDP. The real income gain equals the gain in real output minus the payments for the additional capital services imported from abroad.

4.4 Sensitivity Analysis

The results presented thus far represent our analysis of the reform under the central case elasticity assumptions. As with virtually all economic analysis, the results generated by the model are sensitive to the underlying assumptions, particularly regarding the elasticity values used in the model. While our central case values represent the best estimates of these elasticities, it is important to understand how alternative assumptions would affect the results.

This section discusses the sensitivity of the results of sales tax reform to a range of plausible estimates of the key elasticities values in the model -- the own-price elasticity of demand for consumer goods and the elasticity of substitution between factors of production.

Reducing the elasticities in final demands by 20% reduces the real income gain, although not significantly. Similarly, increasing the final demand elasticities by 20% increases the real income gain slightly.

As expected, the final demand elasticities have no effect on real output because of the small open economy assumption. In other words, commodity prices faced by producers or consumers are tied to the world prices and any

change in consumer demand for goods would be met by changes in trade flows.

The results are more sensitive to variations in the substitution elasticities between factors of production. This is explained by the fact that capital is assumed to be perfectly mobile internationally. Increasing the substitution elasticity has the effect of allowing producers to more easily increase the use of capital services in the production process in response to the removal of the sales tax on capital goods. With capital being internationally mobile, relatively small price changes can give rise to large international flows.

Increasing the substitutability between factors increases the effects of the distortions caused by the existing sales taxes and thereby increases the output gains from the removal of these taxes. Reducing the elasticity values by 20% reduces the overall output gain to about 1.2%. Increasing the values by 20% causes the output gain to rise to about 1.7%. These results are shown by sector and by region in Tables 3 and 4, respectively.

This sensitivity analysis suggests that the empirical results are fairly robust across a range of reasonable elasticity values, but that large changes in the values of factor substitution elasticities could have significant impacts on the real output gains.

Table 3

Sectoral Real Output Effects Under
Different Factor Substitution Elasticity Values
(percentage change)

Sector	Factor Substitution Elasticities		
	Lower Bound	Central Case	Upper Bound
Primary	2.7	3.3	3.8
Food/Beverage/Tobacco	0.3	0.3	0.3
Manufacturing	1.2	1.4	1.6
Construction	1.2	1.6	1.9
Transportation and Utilities	2.5	3.1	3.6
Services	1.2	1.6	2.0
CANADA	1.2	1.4	1.7

Table 4

Regional Real Output Changes Under
Different Factor Substitution Elasticity Values
(percentage change)

Region	Factor Substitution Elasticities		
	Lower Bound	Central Case	Upper Bound
Atlantic	1.2	1.4	1.8
Quebec	.8	1.0	1.2
Ontario	.9	1.1	1.4
Prairies	2.1	2.5	3.1
British Columbia	1.1	1.3	1.6
CANADA	1.2	1.4	1.7

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